THE APPLICABILITY OF ALKALINIZATION IN THE TREATMENT OF TUBERCULOSIS *

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In this discussion we will assume that the constituents of body cells are composed of molecules of colloid material, and these are quite susceptible to the medium in which they are surrounded, whether that be acid or alkaline.

In practically every act of the body, whether it be the voluntary act of muscular exercise or the involuntary processes of metabolism, there is always liberation of acid. Normally, the tendency of the body is to swing toward the acid side, and this would occur uninterruptedly were it not for the fixed bases within the body. The equilibrating body which tends to maintain a normal balance is the alkali reserve.

Any condition in the body which is associated with a pyrexia of long standing must be associated with an acidosis. It will be our attempt to show the efficacy of alkalinization when the acidosis is due to a. tuberculous foci. There is one principle which we should ever bear in mind; i. e., an inadequate supply of oxygen to any portion of the body or the incomplete removal of oxidative products, favors the production and accumulation of acid, and this predisposes to tissue solution.

The body as a whole should be considered as a composite mass of cells with a complex chemical construction, receiving its sustenance through the blood stream. The blood carries in solution or suspension the various products of metabolism or assimilation, and by the proper interchange of absorption and elimination, factors are maintained which promote health. In event a perversion of any of these processes occur, there is a functional or physiologic derangement, which, if persisted in, will produce pathologic changes.

From a physiologic viewpoint the blood should be considered as holding in suspension salts, cells, and other organic and inorganic material. It is alkaline or neutral in reaction, and the principle alkalies which it possesses are the sodium and potassium, carbonates and phosphates. The alkalies also constitute a dominant place in protoplasm, as they hold in combination the albumins with which they are combined. There seems to be a tendency on the part of the body organism to maintain its own alkalinity, and in the event there is a reduction, serious changes may occur. The presence of fibrin in blood plasma should also be borne in mind, and its precipitation or coagulation in certain pathologic lung conditions as pneumonia is well known. Fischer attributes this to acids, or an excess of alkali, principally the former. Another cause is the presence of any foreign body in the blood.

The chief function of a red blood corpuscle is that of a vehicle for the gaseous elements. They carry oxygen from the lung to the tissues, and promote the elimination of carbon dioxide from the body. To provide adequately for these changes, hemoglobin and alkalies must be provided. Hemoglobin in a highly complex protein body, which is able to combine with oxygen, but unable to oxidize it. Because of its ready power of dissociation it acts in a dual role, furnishing the oxygen for oxidative purposes, and withdrawing the chief metabolic offender—carbon dioxide. Carbon dioxide and carbonic acid are principally the end products of any tissue change and metabolism.

A study of the gaseous exchange which is of such vital importance to cellular life is the next step. We find the blood corpuscles contain carbon dioxide and carbonic acid in solution as, phosphates, carbonates, or bicarbonates of sodium and potassium, or as methemoglobin, and convey these substances to the excretory organs of the body. Remembering the diffusibility of gases, and since the tension of oxygen in air is greater than that of the blood, and the tension of carbon dioxide in blood is higher than the outside air, the exchange can readily take place. Naturally, the oxygen of the air passes through the lungs into the hemoglobin in exchange for carbon dioxide and carbonic acid. When this occurs the alkalies are liberated in blood and again assume the function of combining with carbonic acid affinities.

Try and conceive of a picture where there has been an interference in the cycle of exchange of oxygen, carbon dioxide, carbonic acid, and a withdrawal of alkalies. In the first place, a diminution in the supply of oxygen produces cellular acidosis. The affinity of carbon dioxide for water increases the amount of carbonic acid in the blood and tissue, and this produces acidosis. Furthermore, the withdrawal of alkalies from the albumins in solution increases the viscosity of the blood. Any factor which increases blood viscosity reduces the velocity of the blood stream, unless the force behind this is appreciably increased. May not this be a factor in the production of acute dilatation of the heart, which is the terminal manifestation in most tuberculous cases?

The pathology incident with pulmonary tuberculosis is the formation of the tubercle, surrounded by a collateral zone of inflammation. In the process of evolution the capillaries which course to the tubercle undergo certain changes, particularly an endarteritis, and this factor inhibits the normal supply of oxygen reaching the part, and also the incomplete removal of waste products. Carbonic and lactic acids are continuously being formed within the tissue, and the presence of toxins, generated by bacillary infection, plus an increase in H. ion concentration will ultimately produce destruction of lung parenchyma. The evidence adduced by Bradley & Taylor relative to synthesis and autolysis in tissue is extremely interesting. They have shown that when the reaction of the blood swings toward the acid side the reserve protein is transformed into available protein and this undergoes autolysis. They are of the opinion that a greater blood supply and a more complete removal of waste products will reverse the process and lead to laying down of reserve protein and, therefore, to growth of the cell. It is quite plausible that the point of equilibrium being shifted

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would bring about autolysis on the one hand and synthesis of tissue on the other. When we deprive an organ, such as the lung, of its oxygen supply by preventing the normal influx or preventing the normal efflux, the resulting accumulation of acid is obvious, and as the buffer substances become largely exhausted, there is precipitation of colloids, and naturally those which are first attacked are within the lung or that portion of the body, where the oxygen supply is poorest and the production of acid greatest.

In prefacing these remarks we stated that the body cells were composed of colloid molecules. If we are to accept the classification of Fischer, we find two types of colloids. Those which are viscous, gelatinizing, and not readily coaguable with salts—colloid in solution, and those which are non-viscous, non-gelatinizing, or colloid in suspension. The essential difference resides in their relation to the solvent. Those which are in close association with their solvent are known as hydrophilic colloids, and a reverse of the above is known as lyophobic colloids. Fischer is of the opinion that all colloids swell in the presence of acid, and this is probably the first act in the precipitation of lung colloids.

We also know that Vaughan has separated glutanamic acid and other split proteins from the tubercle bacilli, and acid is probably produced by the mixed infection which is always present. One other source for the production of acid, and that again recalls viscosity of the blood. Raising the viscosity of blood prevents the removal of acids which are continuously being liberated in the tissue. The aforementioned gives us multiple sources for the production of acid, and, as Stern has attempted to show, the soluble colloid may then be converted into a gelatinizing mass, and then we have the pathologic picture of a pneumonic area surrounding the tubercle. I mention the last as a probable sequel to production of acid, and this may account for the pathology, but as yet the evidence is rather inconclusive. Allow me to recapitulate quite briefly the source of acid production, so this point may be quite clear. First, a diminution in normal oxygen supply producing cellular acidosis. Second, the affinity of carbon dioxide for water, producing an excess of carbonic acid. Third, increased viscosity reducing velocity of blood current, and inability to remove oxidative products. Fourth, production of acid in the metabolism of foods, and which I will discuss later. Fifth, acid produced by the specific organism, and also those due to mixed infection. Consider the above-mentioned plus hypoalkalinity, due to the withdrawal of alkalies, and then we have a rational indication for alkaline therapy. With the advancing acidity, cell proteolysis, increased hydration, and the conversion of colloids into a gelatinizing mass, we then have the end product from a theoretical viewpoint. Whether this occurs as an actuality, I am unable to state.

Alkalinization can be largely accomplished through the dietary, and, to thoroughly interpret this, it is essential that we decipher, in a measure, the elements in our diet.

In the metabolism of proteins not inconsiderable amounts of acid are formed. If the proteins are improperly used, or used in excess, not only are amins formed, but also toxins are formed which act as acids. In the destruction of this group the amino-fatty acids which are formed are not only acid, but alkaline as well, and as commonly expressed amphoteric. The general opinion is that the action is usually an acid one, and this amphoteric action may be an attempt on the part of nature to compensate for an excess of either acid or alkali within the body. Also in the metabolism of fats, if an insufficient amount of carbohydrate is present, diacetic and beta-oxybutyric acid are formed. A protein diet yields after oxidation in the body 25 per cent excess of acid, while a vegetable and fruit diet yield 25 per cent excess of alkali. It is easier and better for the patient to be liberal with his diet, but to protect him against the effects of an excess of acid by a continuous feeding of alkali where the urine remains persistently neutral to litimus.

In treating tuberculosis, no attempt should be made toward a drastic revision of the dietary, but we should strive for a balance. From the foregoing remarks, one might feel that we were attempting to minimize the protein intake, but such is not the case; it is only for balance that we plead. Fifty per cent of the patients which come under our supervision are "meat eaters," and you will have to teach these patients to eat vegetables. As taste is merely a cultivated matter, these patients will soon "fall in line" if shown the efficacy of a dietary rich in alkalies. I think we sometimes fail to get the optimal benefit of our alkaline therapy, because too little attention is directed toward diet. This cannot be supervised too closely.

Vegetables are combined with bases and weak organic acids which are mostly oxidized to a respirable carbonic acid. There are a few of weaker organic acids, such as oxalic, tartaric, and benzoic, which cannot be oxidized in the body. Foods high in mineral acids or those organic acids which cannot be converted into carbonic acid should be avoided, unless special pains are taken to give with such foods an adequate supply of alkali to neutralize the acid.

It might be well to recall that the vegetables possess a great many salts, and that these will inhibit the precipitation of colloids by rendering the acids inert. This is probably accounted for by the fact that the acid within the cell is replaced by the radical of the added salt.

It would be more or less academic to give a complete list of foodstuffs and their constituents. They may be classified into three divisions. First, those foods which are neutral in action. Second, those which are acid in action. Third, those which are basic or alkaline in character. The latter group comprise all vegetables, fruits, and practically all nuts. The fruit juices are quite palatable, and most of these possess citrates and malates, and much to be desired. In giving fruit juices it is well to bear in mind the high percentage of carbohydrates, and may not be well borne. Two or

three exceptions may be noted in the fruits, viz: plums, prunes, and cranberries.

In the recovery from disease it is essential that the process of restoration be as complete as possible, and that we restore the normal physiologic activities which were in existence prior to the alterations produced by the disease. Our success is entirely dependent upon our ability to reproduce a metabolism within the lung which approaches the normal. In choosing food products, show a preference to those in which the organic acids are readily oxidizable; also those which possess a high content of citrates, malates, tartrates, and benzoates, and preferably with a sodium and potassium base. Ingestion of the above in sufficient quantity will preserve a normal balance of the albuminous substances in the blood and tissue.

Relative to drug therapy, we should give a product which replaces the alkali residents within the blood.

Sodium citrate has been advised in the treatment of pneumonia for quite some time, and its success justifies its continuance. Good results have been obtained, because within the body it is converted into sodium carbonate. The thought may enter the mind of a good many that we probably should give sodium citrate in beginning our alkalinization. This is unwise, as the drug is very irritating to give per mouth. In giving it in solution per rectum it can only be continued for a short period, because of its irritating effects.

There is one other drug which I wish to mention. One that has been used, discarded, used again, with varying degrees of success. This drug is calcium. It is a notorious fact that the workers in the vicinity of lime kilns develop an unusual immunity against the disease. An analysis of the air discloses the fact that there are certain particles floating in the air, and usually these are calcium oxide or calcium sulphate. To claim specificity for this drug is only a narrow conception, and the good results are obtained by raising the alkali reserve within the body. Lime in the presence of water forms calcium hydroxide, and this is caustic or antiseptic, but not to the point of having bactericidal action when within the body. The administration of calcium salts per mouth and intravenously does not seem as efficient as the inhalation method. The deposition of lime salts which occur in healing is another factor for their use.

A great deal of alkali may be administered through the intake of water, and we usually give some alkaline water, either natural or artificial, and it is immaterial whether this be carbonated or still. A favorite of ours is Kalak water. This possesses the bicarbonates of sodium, potassium, calcium, and magnesium. When acidosis is present all the bases of the body are drawn upon. How many of us in the past have attempted to alkalinize our patients by the use of sodium bicarbonate alone? Sodium bicarbonate is insufficient for a number of reasons. Our primary object is to rid the body of carbonic acid, and since sodium bicarbonate is saturated with carbonic acid, it makes a poor carrier. We should prescribe something which in the body is readily convertible into the carbonates and phosphates. Furthermore, by giving the bicarbonate of sodium, we only replace the sodium base within the body. A methodical method of introducing the water is now essential. It is well to give a glass of water every hour through the waking hours. This will permit of at least two quarts being taken each day. It seems to me that there is only one possible objection could be offered to this vigorous administration of water; namely, it will remove through the kidneys various salts which are beneficial.

EXPERIMENTS ON THE BACTERICIDAL ACTION OF THE VIOLET RAY

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Through Dr. T. C. Edwards of Salinas and his interest in the Violet Ray and its action, a series of experiments were conducted in the laboratory relative to the bactericidal action of the Violet Ray.

A culture of staphlococcus pyogenes aureus was obtained from an active case of furunculosis. A minute sub-cutaneous dose of this culture was administered in two minims of normal salt solution to a guinea pig, after a white cell count had been taken. The first leucocyte count was 7,200; the next day it went to 8,000, and the third day to 8,300 with considerable irritation at the point of inoculation. The fourth day, the count was 9,000. Counts taken after the fourth day showed a steady decrease of white cells until recovery.

The remaining portion of the culture of staphlococcus was given a five minute Violet Ray treatment, which was applied to the outside of the culture tube. A transplant was then made. After twelve hours the transplant had an abundant growth. The same treatment was given daily for four days with no apparent effect on the organisms. Thinking the glass tube interfered with the action of the rays, we inserted the glass Violet Ray 'spark tube' into the culture media and gave it longer exposure. This was also done for several days. The longer exposure was sufficient to melt the agar-agar media, but had no effect upon the growth of bacteria so far as could be observed from the daily transplants.

When its virulence was tested out by inoculating a guinea pig with two minims of this culture the result was practically the same as was obtained on the pig receiving the culture before it was treated, showing that the culture was just as virulent after exposure to Violet Rays as before.

At the time of these experiments, Dr. Edwards was treating furunculosis with the Violet Ray and cured many cases after three treatments on successive days with a five to eight minute exposure. He said, the more acute the conditions were, the more quickly they responded, if treated early. One case of beginning infection on the neck was entirely relieved after one treatment. Dr. Edwards also reports a case of folliculitis decalvans (diagnosed as such by Dr. Howard Morrow, of San Francisco) that was showing very marked improvement after thirty days of treatment. The patient left Dr. Edwards at that time,